

National Aeronautics and Space Administration

*Office of Space Science*

STRUCTURE AND EVOLUTION OF THE UNIVERSE  
SUBCOMMITTEE

**of the**

**Space Science Advisory Committee**

**July 10-11, 2001**  
**NASA Headquarters**  
**Washington, DC**

**MEETING REPORT**

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*Paul Hertz*  
Executive Secretary

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*Bruce Margon*  
Chairperson

**STRUCTURE AND EVOLUTION OF THE UNIVERSE SUBCOMMITTEE  
(SEUS)**

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**MEETING MINUTES  
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**STRUCTURE AND EVOLUTION OF THE UNIVERSE SUBCOMMITTEE (SEUS)**

NASA Headquarters, Washington, DC

*Tuesday, July 10*

#### Welcome and Logistics

SEUS Chair Bruce Margon opened the meeting by welcoming participants and reviewing several logistical concerns. He noted that Neil Gehrels, Charles Lawrence, John Armstrong, and Peter Michelson had rotated off the subcommittee, although all four had been invited to participate in the current transitional meeting. Arthur Davidson was not present because he was seriously ill.

Referring to the recent reorganization of the Office of Space Science (OSS), Dr. Margon recognized Anne Kinney as the new Director of Astronomy and Physics. Also present was Alan Dressler, Chair of the Astronomical Search for Origins Subcommittee (ASOS), which would meet jointly with SEUS on the following day. Paul Hertz had replaced Alan Bunner as Executive Secretary of the subcommittee.

#### Theme News

Dr. Bunner began by announcing his new role as Theme Scientist until his retirement in late August 2001. At that time, Dr. Hertz would assume his role. Dr. Bunner thanked the other outgoing subcommittee members for their contributions to the SEUS Roadmap. Their vacancies remained unfilled for the time being. He placed these changes in the context of the OSS reorganization, which was largely in place. Also noted was the selection of Michael Salamon as the new Discipline Scientist for Fundamental Physics and Marian Norris as the replacement for NASA Meeting Coordinator Marilynn Gillette.

Turning to other agency news, Dr. Bunner reported on the flawless June 30th launch of the Microwave Anisotropy Probe (MAP). Now in an elliptical orbit around the earth, MAP was expected to rendezvous with the moon on August 1 and proceed out to L2, which he described as a previously unexploited halo orbit with unique observational potential. He said that the heavy press coverage of this event demonstrated the public's curiosity about cosmology. Staff at OMB had suggested that this highly publicized mission could serve as a selling point for the SEU Cosmic Journeys initiative.

#### SEU State of the Theme Annual Report

Dr. Bunner next commented on the State of the Theme Annual Report, which was given on May 24. Associate Administrator Ed Weiler had used this occasion to note his concern about possible conflicts between the OSS Strategic Plan and the next report of the Turner Committee on the Physics of the Universe, due out in early 2002. He had also expressed his support for an adequate mission operation and data analysis (MO&DA) budget for extended flights.

#### SEU Budget Summary

At this point, Dr. Bunner launched into a broad discussion of funding issues. Although details of the budget were embargoed until final decisions were made in December 2001, two potential shortfalls could be mentioned at this time. One was the budget for the

Space Operations Management Office (SOMO) for FY02 and beyond. The other problematic area was the Gravity Probe B (GP-B) budget. This project continued to meet its essential technical milestones leading to an October 2002 launch, although increases in testing and labor costs could significantly affect the bottom line.

OSS was also developing financial estimates for FY03 to move toward completion of the Laser Interferometer Space Antenna (LISA) and Constellation X (Con-X) projects. The budget picture for Con-X precursor Astro-E2 was generating concern, particularly for NASA's Japanese partner, which expected a final funding decision from the United States by the end of July. Dr. Bunner was skeptical that the larger Explorer budget issues would be resolved by that time, although he was hopeful that the Japanese would wait a little longer to secure NASA's financial commitment to Astro-E2.

Although the National Virtual Observatory (NVO) was scheduled for the next day's discussion, Dr. Margon asked about any provisions being made by NASA to fund it. Neither Dr. Bunner nor anyone else present could confirm its inclusion in the FY02 OSS budget. Dr. Hertz indicated that the agency saw the NVO as a new project requiring financial augmentation rather than as a candidate for Research and Analysis (R&A) support. Discussion ensued about the differences in funding arrangements at NASA and the National Science Foundation (NSF), which were both interested in the project. Interagency dialog on the subject was taking place within a single steering committee. Dr. Margon commented on the irony that the number one small mission of the National Academy of Sciences (NAS) Decadal Survey was having difficulty attracting funding even though it was far cheaper than comparably ranked projects.

#### International Developments

The final item in Dr. Bunner's presentation related to NASA's annual bilateral meeting with the European Space Agency (ESA) last May. At that session, the new ESA Program Director, David Southwood, argued for a global strategy to build complex, expensive projects in X-ray astronomy. Dr. Weiler echoed similar sentiment. Although NASA had invited European participation in Con-X, especially the contribution of light-weight optics, ESA involvement seemed to be limited because the agency's current budget had already been set. In the longer term, however, both sides were now seeking greater collaboration in a field of astronomy formerly divided by separate national programs. Nicholas White represented NASA in the international consultations.

#### Discussion of Theme Successes/Priorities, SOMO, and SIRTf Difficulties

During the ensuing exchange, Dr. Bunner reviewed the degree of success achieved by the Medium-class Explorer (MIDEX) program relative to expectations for it. He cited the accomplishments of the recent MAP mission as limited proof that NASA could achieve better results for less money than attained with previous missions such as the Cosmic Microwave Background Explorer (COBE). To draw the contrast between MAP and COBE too starkly, however, seemed somewhat unfair to him because COBE had been a more complex mission operating in the Challenger disaster aftermath.

Returning to the outlook for future missions, Dr. Margon voiced disappointment that OSS appeared reluctant to move ahead with SEU projects other than LISA and Con-X. Unscheduled midterm missions included the Energetic X-ray Imaging Survey Telescope (EXIST) and the Advanced Cosmic Ray Composition Experiment on Space Station (ACCESS). What, he asked, could SEUS do in the new roadmapping process that was different from what it did in the previous round if the membership still believed projects like EXIST and ACCESS deserved to fly? Harvey Tananbaum observed that mission priorities among all the themes fluctuated and that SEUS members should not read too much into Dr. Weiler's reservations about specific projects at any given time. Dr. Bunner agreed, although he cautioned that it might be unrealistic to expect all recommended missions to be launched, particularly those with imposing price tags and serious technical challenges. Much depended upon formal Office of Management and Budget (OMB) approval of a Cosmic Journeys budget line.

The discussion shifted to the relative impact of the Space Operations Management Office (SOMO) and its Consolidated Space Operations Contract (CSOC) on the SEU budget. Dr. Hertz reported that SOMO had indeed achieved savings for NASA but only about half of what had been anticipated. Meanwhile, NASA space operations costs had increased. As a result, the agency had underfunded space operations, and the various divisions now needed to absorb their prorated share of the shortfall. The SOMO issue loomed as the most pressing budget issue within OSS and the SEU theme. When asked, Dr. Bunner said that he could not offer a logarithmic estimate of the actual SOMO impact on the theme. He did suggest that bookkeeping adjustments could minimize the effect in FY02. In FY03, however, vital technology funds for development of LISA and Con-X could become vulnerable to SOMO diversion. Several participants recommended that questions about the magnitude of the issue and the wisdom of approaching Congress for support be put to Dr. Weiler during the next day's session.

A concluding question focused on the loss of sensitivity in a filter being used in the Space Infra-Red Telescope Facility (SIRTF). Dr. Kinney reported that a shake test had demonstrated that the problem was not a mechanical issue, but engineers had yet to definitively identify the cause; delamination remained one possible explanation. Because the filter still functioned at an acceptable 70 percent of capacity, she believed that mission development should continue on schedule. Replacing the filter would cost \$50 million, and the replacement might perform no better. It would be preferable, she said, to fund research on the cause of the sensitivity loss. The project would pause, however, if the filter defects were found to put other components of the instrument module at risk.

#### Advisory Subcommittee Reorganization

After a break, Dr. Margon shifted the agenda so that the full group could consider the subcommittee merger issues originally scheduled for review in the afternoon. Dr. Kinney initiated the discussion by distinguishing between near- and far-term states for SEUS and ASOS. During the next 18-month strategic planning cycle, it would be useful to maintain discrete structures because of the different operational modes of the two groups, with SEUS engaged in marketing Cosmic Journeys and ASOS absorbed in program implementation. Even in the longer term, there were compelling reasons to communicate

the science of these areas separately. In mission management, however, she did not want two separate bodies still advising her division 5 years hence. Scientists representing both themes needed to sit down at the same table to work out a common agenda. The collaborative process would begin with the joint session scheduled for the next day, and could increase in successive meetings.

In the dialog that followed, participants grappled with several key difficulties associated with subcommittee merger. One was loss of theme identity and the enthusiasm associated with it. Another was coverage of the extraordinary disciplinary breadth resulting from the fusion of two already diverse bodies, particularly in a new structure with only a modest increase in size (total of 20 to 25 members). Dr. Margon agreed that the Space Science Advisory Committee (SScAC) faced a similar challenge, but he also observed that SScAC could rely on specialists in its subcommittees to address technical questions beyond the committee membership's expertise. In addition, under the new arrangement, astrophysics would be represented by only one member on SScAC and would therefore have less input into OSS decision-making relative to that of other subcommittees, such as Solar System Exploration. Participants also discussed the degree to which missions should be assigned to themes by the wavelengths of their science.

Addressing the matter of manageable committee size, Bradley Peterson advised against developing a roster exceeding 25 in the new structure. He drew parallels with the operation of the current Astrophysics Working Group, which he had chaired. Participants discussed how this group interacted with the agency's discipline scientists on tactical issues--a role that Dr. Kinney suggested would continue, with the Working Group chair serving ex officio on the new division's advisory subcommittee.

Dr. Lawrence suggested that the operation of two separate subcommittees did not necessarily pose a problem for the new Division of Astronomy and Physics. Any differences in counsel offered by the separate groups would probably mirror differences in the greater scientific community. Ultimately, as division administrator, Dr. Kinney would have to make her decisions despite these conflicts. Dan McCammon, however, underscored the virtue of having a single council of advisors to sort through various mission options and to present a well-informed set of recommendations. Dr. Kinney assured those present that in the eventual union of the subcommittees, neither ASOS' projects nor those of SEUS would have an assumed financial advantage over the other.

The discussion shifted to the future of the R&A clusters. Dr. Kinney reported that the program scientists in her division recommended bringing R&A into one cluster. The various peer review panels, however, would remain unchanged. This arrangement would allow Dr. Kinney's office the flexibility to make small adjustments to resource allocations on the basis of subscription rates. There would be single grant announcements for individual subareas, such as detectors, but without regard to science wavelength. For OSS, there would be three R&A budgets instead of one.

Questions arose about the relationship of the OSS reorganization to the senior review of the science clusters. Dr. Hertz emphasized that these activities had independent origins

and therefore did not necessarily support or optimize each other. Dr. Kinney indicated that the new R&A cluster arrangements had not yet gone into effect and were not mandated by the new Code S structure. Participants agreed that R&A Director Guenter Riegler could illuminate these issues during his presentation on the following day, as could the recently released results of the senior review.

#### SEU Strategic Planning for 2001-02

During the next program segment, Marc Allen described the strategic planning getting under way in SEU, which would continue as a theme in the new OSS organization. Although the planning team now could take advantage of the published Decadal Survey, the group would have to wait until the winter or spring of 2002 for the widely anticipated Turner Committee report. The relatively late arrival of this document complicated the sequencing of roadmapping activities, which were scheduled to be completed by September 2002. Because of ongoing dialog between committees, Dr. Allen did not anticipate any serious conflict among the Turner report, the Decadal Survey, and the strategic planning process. Dr. Bunner noted that the appointment of a Turner Committee member to the roadmapping team could help reduce the likelihood of incongruous outcomes from these various activities. The roadmapping effort also encompassed other inputs and milestones that Dr. Allen briefly described. Dr. Bunner recommended that the process take into account the High-Energy Physics Survey from NAS.

Asked by Dan Lester about the lessons learned from the previous strategic planning cycle, Dr. Allen replied that the next SEU Roadmap needed to be shorter, a view supported by OMB's reaction to agency requests, according to Dr. Kinney. Dr. Allen also suggested that the technology section needed improvement and would benefit from Harley Thronson's contributions. Finally, he said that adoption of a simple and potent SEU symbol equivalent to the Mars rock of ASO could invigorate and help sell the Cosmic Journeys initiative. A general discussion ensued about the challenge of finding anything in astrophysics comparable to that ASO touchstone. Dr. Allen proposed that dark energy, relativistic time, and extra dimensions--concepts being addressed by the Turner Commission--could capture the public's imagination. Dr. Margon expressed concern that these issues, while highly significant, did not represent the full breadth of the astrophysics community.

#### Writing the Roadmap

Dr. Hertz agreed to speak about the SEU Roadmap process earlier than scheduled. He requested that the new document reflect more scientific focus by starting with a presentation of distant, compelling goals and following through with the necessary intermediate steps. SEU and the Solar System Exploration themes fell short of ASO in carrying out this task during the last planning cycle. It was important, he said, to address an audience wider than that contained within OSS.

The development of the SEU Roadmap, Dr. Hertz proposed, could begin with an ad hoc coordinating team rather than SEUS. During the summer, the group could review the Decadal Survey, first report of the Turner Committee, and the Cosmic Journeys initiative

and then move toward the development of ad hoc working groups in the fall, whose efforts would eventually feed back to the main team. Eventually, SEUS would receive and evaluate the final draft, but OSS management remained its ultimate destination.

It was noted that the last strategic process involved nine working groups divided largely by wavelength. Some SEUS members questioned the wisdom of convening yet another generation of temporary committees to churn the same issues with a probable outcome resembling the current Cosmic Journeys initiative. Dr. Hertz and others argued, however, that the Decadal Survey and previous Roadmap had not been sufficient to market Cosmic Journeys effectively and that broad community buy-in from personal input into the new initiative would provide a much-needed boost. Dr. Margon agreed that extensive participation during the last roadmapping cycle had not carried over into the formulation of Cosmic Journeys, which originated from only a few direct advocates. At this point, the subcommittee decided to break for lunch and to resume the discussion afterward.

After lunch, the conversation returned to the composition and charge of the SEUS roadmapping team. Dr. Margon summarized several members' concerns voiced during the break about the agency's intention to carry out the roadmap function outside SEUS. If the current membership was the issue, why not just reconstitute the body and charge it with the task? Dr. Hertz replied that he wanted to make certain that the team had the breadth and marketing skills to address the challenge and that he did not want to limit membership to those who served or would serve on SEUS. He also reiterated that he had not been sold on the idea that Cosmic Journeys enjoyed strong concurrence in the scientific community. Along with Dr. Bunner and Dr. Gehrels, he emphasized that the astrophysical landscape had changed since the last strategic planning cycle in ways that had to be taken into account. Dr. Margon conceded that some level of reconnection with the academic established seemed appropriate, but he continued to question whether this should be accomplished through a massive recruitment of individuals already fatigued from present or past memberships on similar committees. He and Dr. McCammon also doubted whether university researchers really cared about how their projects were packaged and sold to OMB.

Also of concern to the chair, Dr. McCammon, and Dr. Lawrence was the fate of missions that did not fit neatly into a sleek marketing document. Would not the roadmapping process in this context actually exacerbate tensions between those within and without the highlighted disciplines? On the other hand, replied Dr. Hertz, why should NASA try to market missions that could not be sold? Dr. Dressler stressed the need for SEUS to embrace a pared-down, coherent storyline that would win for Cosmic Journeys what it had failed to achieve during the last planning round. Finally, Dr. Tananbaum advocated forming two committees--one chartered to canvass the scientific community and develop a fresh and detailed roadmap, and another body to compose a cogent marketing plan for Cosmic Journeys.

#### LISA Update



Sterl Phinney began the next meeting segment by revisiting the basic science mission of LISA--specifically, the detection of gravitational waves associated with binary stars, emerging black holes, and compact objects captured by massive black holes. Overhead projections showed various examples of calculated waveforms for colliding black holes.

Dr. Phinney also summarized the quasi-independent evolution of the project on both sides of the Atlantic and the recent formation of a U.S.-European management team, which had convened in June 2001 for the first time. A chart identified the various working groups, whose membership and leadership reflected equal European and American participation.

The remainder of the presentation focused on the technology drivers of the project. Because Dr. Phinney had discussed the first one, the interferometer, in the previous SEUS meeting, he now concentrated on the other two: the accelerometer (gravitational reference unit) and the micronewton thrusters.

After describing the deployment of the three-satellite system and the instrumentation for monitoring the test masses, he outlined the sequence of missions that would generate the successive increases in accelerometer sensitivity leading up to the standard set for LISA. The accelerometer on CHAMP, a German geodesy precursor mission, had already posted a yearlong track record and had met its performance goals to date. The Superstar accelerometer on GRACE, the next (November 2001) mission in this line, was expected to perform 10 times better than CHAMP's. LISA managers hoped that the subsequent microSCOPE and GOCE/GRADIO missions would enhance accelerometer performance even further. Much would be riding on the 2006 SMART-2 flight, which would test the European accelerometer and, possibly, the ST-7 NASA payload. LISA would not fly until at least 4 years later.

The micronewton thrusters, once thought to present a serious technical challenge, had ceased to be a major concern at this point. Longevity remained an issue only because the current units had been running for just 6 months. Thus far, however, they had satisfied the requirements for noise, resolution, and linearity. There was still some attention being given to possible contamination of optics by their operation. A number of thrusters with the most technical heritage, developed in Austria, had arrived at NASA for further testing.

#### Technology Initiatives and Issues

The next presenter, Harley Thronson, started with an overview of his new roles as Director of Technology and as Senior Science Lead of NASA's Exploration Team, a future program of Code S and Code M. His duties as Technology Director included assessment of long-term technology priorities, development of new technology budget initiatives, and service as OSS technology liaison.

Dr. Thronson noted that up until recently, Code S had relied on Code R for technology development; now OSS had assumed this responsibility for itself. The funding for the shift represented new money rather than resources pulled out of Code R. (During his 5-

month tenure in his new position, his relations with Code R staff had been cordial, he reported.) Added together, the OSS technology initiatives reached the \$200 million level, whereas the Code R technology budget approached \$1.8 billion. OMB presently seemed receptive to increases in new technology funding for OSS even though the Administration did not support new initiatives like Cosmic Journeys. Projects such as LISA and Con-X could continue on course even without a funded mission line if their technology development requirements were packaged as budget augmentations.

Although the Technology Division did not have an official strategic plan, Dr. Thronson summarized the basic components of the Technology Implementation Strategy due for completion by late autumn. These included the evaluation of technology maturation and infusion mechanisms, as well as partnerships, analytical tools, investment plans, and solicitation strategies. He also described recent assessments to determine priorities among enabling technologies for OSS missions, including in-space propulsion, information processing, large optics, and unconventional launch systems. Overhead projections displayed the range of applicable propulsion and power technologies, from solar sail and chemical sources to nuclear, for specific future missions.

Turning to an administrative issue of import to SEUS, Dr. Thronson alerted participants to two recent agency actions concurred with by OSS. The first stipulated that NASA-funded software must be approved for release or sale. The second action would require a process to be put in place for product commercialization in all NASA projects. Under this arrangement, project managers would work toward a goal of commercializing up to 20 percent of their technology funding. Although the first rule seemed to have taken effect already, the second was still being reviewed. Both actions appeared to originate from the highest level of the agency, even though their immediate source was Code R. They reflected the strongly held belief that NASA should develop products for industrial application. Dr. Thronson suggested that SEUS, if interested, could ask for time to comment on these rules.

Dr. Margon took strong exception to the actions just presented, particularly the first one, because virtually every research project involved writing at least a line of computer code. Academic researchers, however, did not have the authority to negotiate or relinquish the rights of products developed at universities and controlled by their contract officers and regents. The biggest danger, he warned, would be for NASA to delegate the administration of these rules to the agency centers overseeing grants and contracts. He cited the case of the "infamous" NPG2810 information security requirement, whose maladministration by technical officers at agency centers effectively killed numerous campus research projects. It was crucial, he continued, for NASA to deploy such rules for internal headquarters use only rather than to entrust field technicians with the discretion to monitor and enforce compliance in grants and contracts.

#### VSOP-2 Status

At this point, SEUS turned to consider a proposal in the process of possible reformulation.

Speaking on behalf of the international VSOP-2 project, Ed Fomalont briefly described how this endeavor would follow what was essentially a Japanese engineering mission launched in 1997 and due to terminate in February 2002. By most accounts, the original VSOP had been a technical success but had yielded only modest scientific returns. In the field of very long baseline interferometry (VLBI), the next major mission on the horizon was the Advanced Radio Interferometry between Space and Earth (ARISE) mission--perhaps 15 years away. Dr. Fomalont hoped that VSOP-2 or some variant could launch many years sooner and accomplish at least some of what was envisioned for ARISE or even exceed those expectations.

One option involved the same size payload as VSOP but with major technical improvements: more/bigger antennae, lower noise temperature, wider band width, and a 10-fold increase in sensitivity. By launch day 6 or 7 years hence, however, this VSOP-2 package might not hold any performance advantage over enhanced ground-based instruments. For this reason, project proponents were considering flying two satellites, which would allow for imaging in two directions, a 100,000-km apogee, and much higher resolution. This more ambitious project required substantial international collaboration, partly because it would cost twice as much as the \$200 million single version. Even a \$50 million contribution from NASA, however, would exceed the \$35 million cap for missions of opportunity (MO), and the issue of controlling interest complicated participation in the Explorer program. Because discussions at the Jet Propulsion Laboratory (JPL) had failed to produce a clear strategy, Dr. Fomalont was approaching SEUS for guidance.

In response, Dr. Margon reminded Dr. Fomalont that OSS was embarking on another strategic planning cycle and that the VSOP-2 team could meet with the appropriate roadmapping group to make a strong scientific case for inclusion. Dr. Tananbaum, however, pointed out the difficulties of entering a field crowded with well-established competitors. Another strategy, he suggested, would split the two satellites into separate missions, one of which could seek NASA funding under the MIDEX price cap, with the remaining costs picked up elsewhere. Dr. Lawrence suggested abandoning the Japanese plan altogether by considering smaller antennae and much better receivers that would yield higher sensitivity and spectacular UV-plane coverage of active galactic nuclei (AGOs). In Dr. Peterson's view, the VSOP team needed to make a convincing case that the proposed instrument could provide high-quality resolution of objects within the appropriate time scale.

#### Explorer and Astro-E2 Update

Returning to report on the Explorer program, Dr. Hertz mentioned several news items, including the cancellation of the student demonstration CATSAT mission; the establishment of \$180 million and \$85 million costs caps for FY02 MIDEX and SMEX projects, respectively; and the release of the MIDEX announcement of opportunity (AO) on July 16. The SMEX 8 and 9 calendar had changed little from his last report to SEUS.

Dr. Hertz's review of the Explorer launch program touched on the Pegasus failure for HESSI, the continuation of GALEX toward launch despite setbacks, the confirmation of

CHIPS for phase C/D, the confirmation of CINDI for phase B, the current CDR for Swift, and the descoping of FAME to remain under the cost cap.

MIDEX policies had not changed substantially, he noted. Astrobiology missions could take the normal ASO theme route or could compete as MO projects cosponsored by Code U. OSS was also soliciting free flyers and payloads attached to the International Space Station (ISS). Goddard Space Flight Center GSFC) procurement services were offered, but not use of the Spartan 400. MO policies extended to long duration balloon flights of 10 days or more.

Dr. Hertz concluded by observing that there were no new developments to report on the fate of Astro-E2. Echoing Dr. Bunner's earlier statements, he indicated that NASA was still trying to resolve budgetary uncertainties before committing to the project, but that the patience of the Japanese was wearing thin.

#### ACCESS and EXIST Update

The final report of the day reviewed progress on the ACCESS mission. Vernon Jones noted that a draft AO for the project had been delayed because of uncertainties about Cosmic Journeys. ACCESS depended on the availability of the large truss on ISS. At the SScAC meeting, members recommended that the agency solicit for ISS attached payloads in a MIDEX AO; the suggestion was accepted. Another decision led NASA to offer in the MIDEX AO an interface bus between the science instruments and ISS; this bus would come as Government-furnished equipment with a price tag of approximately \$45 million. Bidders were free to choose another bus if they wished.

Because of sequencing uncertainties among ISS missions, ACCESS might not fly until 2008. These uncertainties had affected the calendar for proposal selection and mission planning and threatened the continuity of the ACCESS work team. Assuming that he could find modest funding, Dr. Jones hoped to use the interruption in the mission schedule as an opportunity to conduct low-level preformulation studies on EXIST, which could follow on the heels of ACCESS. He cautioned that there would be other contenders for the MIDEX slot tentatively designated for ACCESS.

Overall, Dr. Margon concluded that ACCESS might warrant a little more confidence than it did earlier. The ISS continued to develop, and in Dr. Jones' view, the truss was vital to the future of ISS science because it provided power to the autonomous payloads that would be attached.

At this point, Dr. Margon briefly previewed the schedule for the next day of the SEUS meeting. He noted that most of the time in the morning could be devoted to the development of recommendations to the Executive Secretary, but that members could also review critical science issues to be included in the next SEUS Roadmap. He adjourned the meeting at 5 p.m.

*Wednesday, July 11*

Discussion of Recommendations Letter and Roadmapping Science Issues

The morning session of the second day was devoted to drafting a tentative letter of recommendations from the subcommittee to the SEUS Executive Secretary. These suggestions would be subject to possible revision after the joint session with ASOS. Dr. Margon suggested that he could rely on e-mail to receive and incorporate any changes proposed by members after the meeting. (The final document appears in the appendix of this report.) He also noted that participants could use the morning period to identify or refine science issues that the new roadmapping entity should take into account.

*SEUS/ASOS Joint Session*Space Science Overview

Associate Administrator Weiler provided a program update for the two subcommittees. The FY02 President's budget proposed \$2.453 billion (\$2.786 billion full cost, including civil service salaries) for the Space Science Enterprise. This budget included a \$500 million increase to the Mars Program from 2002 to 2006. There was significant new funding (\$200 million) to begin an in-space propulsion research program to enable a potential Pluto "sprint" mission. This was a research (not development) program. There were funds for critical technology for future decisions on two astrophysics missions—Con-X and LISA. There were additional funds to correct deficiencies in the Hubble Space Telescope (HST) and SIRTf, keeping these missions on schedule. Funds for Solar Probe had been deleted. Dr. Weiler discussed the features of the augmented Mars Program. The funding included upgrades to the Deep Space Network.

Although funding for Pluto-Kuiper Express was not included in the FY02 budget because of mission deletion, Congress nevertheless directed that AO activity proceed up to the point of selection. The selection would be on hold until the Congress acted and the President signed the budget.

With respect to Solar Probe, the NAS has been asked to define the critical science in the solar and space physics field. In the event that Solar Probe was assigned a high priority, the mission could be funded out of the resources planned for other solar and space physics programs.

OSS was now acting under the new, streamlined organization. Mars Odyssey was launched in April and all was going well. MAP had been launched in June and had generated a lot of press interest. This mission would probe conditions in the early universe. There was a potential fix to the problem on Huygens to avoid loss of scientific data. Dr. Weiler showed some Mars Global Surveyor (MGS)/MOC images of Cydonia on Mars that had been popular in the press. There had been significant funding shortfalls in Space Operations over the budget runout due to optimistic estimates of savings from consolidating space operations, mission extensions, and high flight rates due to "faster, better, cheaper." OSS' decision was to reduce the baseline content to cover the shortfall. The bill over the next 5 years would be about \$400 million. There would be no major program/project cancellations, but many baseline missions would be delayed. Also, future Discovery and Explorer AO's would be delayed. Dr. Weiler indicated that he did

not intend to transfer \$400 million to Code M without caveat; OSS must have management control over its part of operations. He outlined the allocation ground rules. JPL requirements were allocated to Solar System Exploration; GSFC requirements were divided between Astronomy and Physics and Sun Earth Connection (SEC). Dr. Weiler could not discuss the impacts to any specific mission, but indicated some of the boundaries. All changes to the baseline must be approved by OMB and Congress prior to implementation. Dr. Weiler reviewed some of the language from the House Appropriations Subcommittee that came out today. Overall, there was a 1 percent reduction in the OSS budget. It recommended a number of “adjustments” (earmarks).

The subcommittees discussed the SOMO issue. Although OSS had received warning of some problems about 2 years ago, it had not been clear at that time whether it was a budget problem or a management problem. It was clear now that there was a budget problem that could not be solved by better management. SOMO issues would have significant impacts on NGST, SIM, the Mars Exploration Program, Con-X, Europa Orbiter, future Discovery missions, future Explorer missions, the Solar Dynamics Observatory, the SEC guest investigator program, and New Millennium flight validations. No current Discovery or Explorer missions would be canceled or slowed; delays would only affect future AOs. R&A and data analysis would not be impacted.

OSS would continue to push technology initiatives; however, this year, NASA was facing the results of the tax cut. OMB had been receptive to technology initiatives in the past. OSS was actually getting a lot of advantages from the Code R activities. Dr. Weiler challenged all of the advisory groups to look at R&A and ask why more of that effort was not going into technology development.

With respect to Cosmic Journeys, there was still something missing, although it was hard to identify. Fundamental physics seemed to garner the most interest from OMB. The important thing was to meet the milestones that were promised to OMB.

Dr. Weiler provided his perspective on what had worked and what had not. OSS had received many kudos for making tough decisions and striving to peer-review almost every program. This Administration was very intent on making sure that what could be done outside Government agencies and laboratories was done there. It was important that the NASA Centers got this message; capabilities at the NASA centers would be maintained only if they could not be maintained elsewhere. Under this Administration, there would be even more emphasis on competition.

#### Data Centers and NVO

Dr. George Helou discussed the state of the astrophysics data archives system. The data services and centers fell into three main categories: the mission science centers; the wavelength- focused science archive centers; and the permanent archive. In addition, there were integrating services that were more object oriented. The current system was vigorous and productive. It was responsive to mission needs and heavily used by the community. It had been highly rated by a senior review process. Dr. Helou showed some recent science results that had come directly from archival research. The HST and

the IPAC Web sites were rated by outside experts as “most popular” and “recommended.” IPAC’s infrared astronomy tutorial was a multiple award winner, as were the HEASARC sites. NED touched many constituencies besides researchers. The NAS had recommended the next level of data archive exploitation. An NVO would provide dynamic access to distributed terabytes of images, spectra, and catalogs. New frameworks, software, and network tools were needed to fully exploit today’s surveys. The challenges were how to maintain excellent and up-to-date archives and make room for more innovative science services and an NVO.

Dr. Robert Hanisch discussed the status of the NVO initiative. The NAS Astronomy and Astrophysics Survey Committee (AASC) Decadal Report ranked an NVO as the highest priority small-scale project. The first large-scale conference had been sponsored by and held at Caltech in June last year. The Europeans had sponsored a conference in Germany in July. NASA had sent out a Dear Colleague letter in October 2000, and there had been a special session at the AAS in January 2001. The Steering Committee had made a decision to pursue the NVO framework development through the NSF Information Technology (IT) Research program. The goal was to create the IT framework and demonstrate select science prototypes. The program included international and education partners. Funding for the NVO via the NSF IT program was doubtful—the program was oversubscribed by a factor of 10. In any case, NSF funding would not cover full implementation. NASA’s astrophysics data centers were the cornerstones of the NVO, but were not sufficient in themselves. Much effort was required to develop data location and integration services. The computational services and network bandwidth needed improvement at the primary NVO services sites. NASA programs existed in these areas, but they were not currently aligned with the initiative. Several European virtual observatories had been proposed and were funded. The NVO should be developed in step with these initiatives. The NVO was continuing to get attention. There were a number of conferences over the summer and fall. The estimated total development and operations cost over 10 years was about \$60-\$70 million—similar to a SMEX. The question was how the NVO could be incorporated into NASA’s astrophysics missions. There was more information on the Web site: <http://www.voforum.org>.

Mr. Joseph Bredekamp discussed NASA’s view of the NVO initiative. With respect to funding, much of the foundation pieces had been sponsored through OSS’ data center efforts. The current solicitation targeted the priority areas for the NVO. OSS was partnering with other elements in the agency to support the NVO and was working with NSF to have more coordinated activity. A Science Definition Team has been formed to define and formulate a joint NASA/NSF initiative to pursue NVO goals. The current issue was funding support. NASA was working to put forward an augmentation, but it competed with other program elements. Definition funds (about \$1 million) had been identified for FY 2002; however, there was not an approved wedge for the initiative. The earliest opportunity for a new initiative (the best approach) was probably 2004. The issue was where to take the money. Dr. Kinney suggested linking the NVO to a larger initiative, e.g., the technology initiative. Dr. Stockman felt that the archives should do what they can now to align with the NVO. Initial experiments using NVO should be encouraged under the R&A program. Dr. Lawrence observed that the level of funds

involved was strictly in the noise level for Congress. He felt that there was no need to go outside NASA for a solution to this problem; it should be solved within OSS. Dr. Peterson felt that NSF should take the lead and request the augmentation. Both of the subcommittees recognized the NVO as a good idea that should not wait until 2004. OSS should look at options on how the program could move forward sooner rather than later. SEUS supported the idea of creating a memorandum of understanding between NASA and NSF as soon as possible.

#### Future of Advisory Subcommittees

Dr. Dressler summarized the ASOS discussion on this topic. In the near term, the subcommittees would try to meet together to address common issues to avoid any conflicting advice. There was a preference (at least in the near term) to keep the FACA subcommittees as the groups that would support and nurture the missions. Dr. Margon indicated that SEUS did not envision dissolving itself before the roadmap activity was completed (about a year and a half). SEUS would like to retain separate identities and meetings, but have an informational plenary session and a joint final session. One of the questions was the degree to which OSS continued to advocate science within the thematic structure. There was more logic for separate committees if this continued. Dr. Kinney indicated that her primary concern was getting conflicting advice. Dr. Dressler suggested a 2-day meeting, starting with a joint, informational session; and ending with a final joint session.

Dr. Margon noted that this would be Dr. Bunner's last SEUS meeting before his retirement. The subcommittee thanked him for his dedicated effort on behalf of the community.

#### Update on R&A Programs and Organization

Dr. Guenter Riegler reviewed the new organization as compared it to the old structure. The old organization had contained some very good features. The Flight Program Division had established good checks and balances for mission development, and program management had been tightened up in a uniform way. In the research area, some of the NRA elements had been combined into standard boilerplate. However, the Program Scientists and the Program Managers had been in different organizations and physically separated. Since 1995, OSS had gradually been able to add civil servants and visiting scientists. The new organization reflects a streamlining of management. It was actually a return to a topical (rather than functional) organization. All of the Program Managers and Program Scientists would be in the same organization. Mars Exploration was special because the Young Committee made a very strong point regarding the diffusion of responsibilities at NASA Headquarters. The Director for Mars Exploration was in a separate office. In order to preserve some of the positive aspects of the former organization, Dr. Riegler and Dr. Ledbetter were Executive Directors that would concentrate on the cross-cutting elements. In addition, Dr. Thronson would focus on long-term technology issues. Near-term technology issues would be handled within the divisions. Dr. Rosendhal was the Director for Education and Public Outreach, and Dr. Allen was the Director for Strategic and International Planning.



Dr. Riegler discussed the recent R&A Senior Review. The community and the advisory committees recommended looking at the balance across the three elements of the Enterprise (research, flight mission development, and MO&DA), as well as balance within each component. There were good balancing mechanisms within flight mission development. The MO&DA senior review is the balance mechanism for MO&DA. However, there was not a balancing mechanism for R&A, and this was one of the reasons for doing a R&A senior review. Another reason was the Government Performance and Results Act (GPRA), which required that the organization have an assessment for everything it does. A NAS report indicated that a triennial review of R&A would meet the requirement of GPRA. The R&A programs were assessed in terms of merit and relevance to the goals set by the science community and the goals in the strategic plan. All of the R&A programs were grouped into nine science clusters or two functional clusters (the theory program and information systems). The Senior Review Committee received a report from each of the eleven R&A program clusters in May. The committee looked at merit and relevance, budget distribution, R&A program structure, and new initiatives or augmentation. The committee was impressed with the high quality of the R&A reports and found that the OSS R&A program was essential to realizing the full potential of flight missions. It found that the individual R&A clusters were oversubscribed by substantial factors and recommended that the R&A program be augmented. Dr. Riegler noted that there was no current plan for an augmentation, but this could be considered in the next strategic planning cycle. The committee developed a categorization for the R&A Programs. If there was a general augmentation, the committee recommended that the clusters in Category I receive additional funds. Three clusters were recommended for special augmentation: the Astrophysics Theory Program; Geospace sciences; and Origin and Evolution of Solar System Bodies.

Category III (Information Systems) was asked to develop a plan to response to the three specific issues listed in the R&A review report. The Information Systems program would be reduced by \$1.5 million in FY 2002 and by \$3 million during FY03 and FY04. With respect to the special augmentation/new initiatives, OSS would provide additional funds for the three clusters identified by the committee. Each would get an additional \$0.5 million in FY02, an additional \$1.0 million in FY03, and an additional \$2.4 million in FY04. The funds would come in part from the diverted Information Systems line. Beginning in FY02, there would be an across-the-board 3 percent increase per year in R&A. In response to a comment, Dr. Riegler noted that a recommendation from the subcommittee regarding larger “group” grants in the Astrophysics Theory Program would be welcome. With respect to the structure, the committee found that the current clustering seriously lacked uniformity; it recommended that the clusters be restructured so that the program content was uniform amongst them. Dr. Riegler indicated that OSS would respond to this recommendation and would realign some of the clusters.

STRUCTURE AND EVOLUTION OF THE UNIVERSE SUBCOMMITTEE  
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**SEUS MEMBERSHIP**  
Appendix A

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**MEETING ATTENDEES\***  
**Appendix B**

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Lester, Dan	University of Texas
McCammon, Dan	University of Wisconsin
Peterson, Bradley	Ohio State University
Phinney, Sterl	Caltech
Simon Swordy	University of Chicago
Tananbaum, Harvey	Smithsonian Astrophysical Lab

*NASA Attendees*

Bunner, Alan	NASA Headquarters
Correll, R.	NASA Headquarters
Gehrels, Neil	GSFC
Hansen, Hashima	NASA Headquarters
Horowitz, Steve	NASA Headquarters
Kniffen, Donald	NASA Headquarters
Kinney, Anne	NASA Headquarters
Jones, Vernon	NASA Headquarters
Lawrence, Charles	JPL
Norris, Marian	NASA Headquarters
Ockaepo, A.	NASA Headquarters
Riegler, Guenter	NASA Headquarters
Sadof, Donna Walls	GSFC
Salamon, Michael	NASA Headquarters
Sorrels, C.L.	NASA Headquarters
Thronson, Harley	NASA Headquarters
Weiler, Ed	NASA Headquarters
White, Nicholas	GSFC

*Other Attendees*

Burrowbridge, Don	Self
Beres, Kathleen	TRW
Di Biasi, Lamont	L. Di Biasi Associates
Dressler, Alan	Carnegie Institution
Fomalont, Ed	NRAO
Kovsmo, Charles	Self

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\*Does not include ASOS members (except for those attending the SEUS meeting)

**STRUCTURE AND EVOLUTION OF THE UNIVERSE SUBCOMMITTEE  
July 10-11, 2001  
NASA Headquarters**

**LIST OF PRESENTATION AND OTHER DISTRIBUTED MATERIALS  
Appendix C**

*Presentations*

SEU Theme Scientist's Remarks [Bunner]  
Technology Priorities & Initiatives [Thronson]  
SEU Strategic Planning 2001-2001 [Allen]  
Explorer Program Update [Hertz]

*Circulated material*

Assessment of NASA's Space Science Research and Analysis Programs [Riegler]